TABLE 2.—*Free-air resultant winds (meters per second) based on pilot balloon observations made near 7 a. m. (E. S. T.) during August, 1929*

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)		Brulington, Vt. (132 meters)		Cheyenne, Wyo. (1,868 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Havre, Mont. (762 meters)		Jacksonville, Fla. (65 meters)		Key West, Fla. (11 meters)		Los Angeles, Calif. (40 meters)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Meters	°		°		°		°		°		°		°		°		°		°	
Surface	S 15 E	1.4	S 32 W	1.8	N 79 W	2.2	N 43 E	0.7	N 12 W	1.0	S 17 W	1.6	S 63 W	3.4	S 70 W	0.9	S 59 E	2.2	N 73 W	1.9
500	S 13 W	6.1	S 68 W	3.7	----------	----	N 8 E	1.3	N 46 E	0.7	S 38 W	7.6	----------	----	S 90 W	2.6	S 60 E	5.2	S 74 E	1.2
1,000	S 48 W	7.0	N 82 W	5.2	----------	----	N 12 W	1.9	S 24 W	1.8	S 16 W	4.6	S 37 W	2.0	S 77 W	2.7	S 59 E	4.6	N 7 W	0.6
1,500	S 66 W	4.2	N 82 W	5.2	----------	----	N 54 W	2.7	N 70 W	1.7	S 23 E	2.9	S 73 W	3.4	S 69 W	2.2	S 52 E	4.0	N 80 W	0.7
2,000	N 89 W	2.2	N 75 W	6.3	S 85 W	3.4	N 64 W	3.7	N 71 W	3.1	S 76 E	3.0	S 83 W	4.7	S 66 W	2.2	S 54 E	3.1	S 45 W	2.1
2,500	N 57 W	1.8	N 79 W	6.6	S 75 W	3.2	N 70 W	4.4	N 69 W	5.2	N 86 E	3.0	S 84 W	5.7	S 55 W	2.1	S 51 E	2.6	S 21 W	2.9
3,000	N 18 E	1.5	N 68 W	7.8	S 88 W	3.8	N 72 W	4.3	N 65 W	6.3	N 83 E	3.4	S 82 W	7.2	S 61 W	2.1	S 67 E	2.4	S 4 E	4.2
4,000	N 43 E	2.0	N 69 W	8.8	N 84 W	3.2	N 74 W	5.5	N 50 W	9.4	N 89 E	4.0	S 82 W	9.7	S 38 W	1.6	S 45 E	2.4	S 29 E	4.7
5,000	N 14 E	2.1	----------	----	N 55 W	2.8	N 71 W	5.6	N 47 W	7.6	S 71 E	4.6	S 87 W	12.5	S 45 W	1.4	S 34 E	1.6	S 7 W	1.3

Altitude m. s. l.	Medford, Oreg. (446 meters)		Memphis, Tenn. (145 meters)		New Orleans, La. (25 meters)		Omaha, Nebr. (313 meters)		Royal Center, Ind. (225 meters)		Salt Lake City, Utah (1,280 meters)		San Francisco, Calif. (60 meters)		Sault Ste. Marie, Mich. (198 meters)		Seattle, Wash. (67 meters)		Washington, D. C. (34 meters)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Meters	°		°		°		°		°		°		°		°		°		°	
Surface	S 26 E	1.2	S 67 E	1.1	N 11 W	0.5	S 59 E	1.0	S 36 E	0.7	S 27 E	3.3	S 58 W	2.2	N 45 E	0.2	S 62 E	1.6	N 26 W	0.7
500	S 30 E	0.9	S 76 W	0.1	N 46 W	2.5	S 13 E	3.8	S 26 W	1.9	----------	----	S 45 W	3.5	S 73 W	1.9	S 28 E	1.5	N 23 W	2.8
1,000	N 78 W	0.4	N 55 W	2.3	N 45 W	0.6	S 37 W	4.7	N 72 W	1.9	----------	----	S 82 W	4.6	N 74 W	4.3	S 61 E	0.4	N 35 W	2.9
1,500	S 84 E	0.9	N 59 W	3.7	S 68 E	1.0	S 87 W	4.1	N 53 W	4.4	S 25 E	5.8	S 38 W	4.0	N 61 W	5.2	N 67 W	0.6	N 60 W	4.5
2,000	S 3 W	2.4	N 34 W	2.9	S 82 E	1.4	N 74 W	3.9	N 53 W	6.1	S 7 E	4.8	S 41 W	4.5	N 61 W	5.9	N 83 W	3.1	N 61 W	5.4
2,500	S 18 W	6.3	N 9 W	3.6	S 80 E	1.6	N 70 W	4.5	N 50 W	7.0	S	3.0	S 25 W	5.6	N 46 W	8.2	N 86 W	4.2	N 53 W	5.9
3,000	S 20 W	8.3	N	3.5	N 61 E	1.8	N 62 W	5.8	N 48 W	7.2	S 11 W	3.3	S 29 W	4.5	N 37 W	7.8	S 78 W	4.3	N 49 W	5.4
4,000	S 25 W	10.9	N 22 W	2.9	N 55 E	2.1	N 68 W	6.8	N 54 W	7.0	S 36 W	4.6	----------	----	N 20 W	8.3	----------	----	N 9 W	8.5
5,000	----------	----	N 46 W	3.1	N 60 E	2.2	N 59 W	7.6	N 39 W	6.3	S 54 W	5.6	----------	----	----------	----	----------	----	----------	----

TABLE 3.—*Observations by means of kites, captive and limited-height sounding balloons, and airplanes during August, 1929*

	Broken Arrow, Okla.	Due West, S. C.	Ellendale, N. Dak.	Groesbeck, Tex.	Royal Center, Ind.	Naval Air Station, D. C.
Mean altitudes (meters), m. s. l., reached during month	2,404	2,118	2,809	1,854	2,659	3,323
Maximum altitude (meters), m. s. l., reached and date	[1] 3,705	[2] 4,120	[3] 4,824	[4] 4,699	[5] 4,693	[6] 4,002
Number of flights made	29	24	30	27	20	17
Number of days on which flights were made	29	23	26	27	20	17

[1] 14th. [2] 4th. [3] 31st. [4] 21st. [5] 15th. [6] 6th.

In addition to the above there are approximately 100 pilot-balloon observations made daily at 45 Weather Bureau stations in the United States.

551.506 (73)

WEATHER IN THE UNITED STATES

THE WEATHER ELEMENTS

By P. C. Day

GENERAL SUMMARY

August, 1929, was notable mainly for the wide extent and persistence of the drought conditions that prevailed in practically all parts of the country, save in a few States embracing the territory from the southern Rocky Mountains westward to the Pacific coast.

In many sections where drought existed during August there had been little precipitation during the latter part of the previous July, and the absence of any extensive precipitation during August resulted in drought conditions of unusual severity, causing marked deterioration in crop growth over considerable areas.

Other weather conditions were not abnormal to any important extent, and the month, as a whole, was comparatively cool in many sections and favorable for outdoor activities in practically all parts of the country.

PRESSURE AND WINDS

The pressure distribution during the month was unfavorable for the development of active cyclones, and, as in July, these storms were infrequent and maintained their identity as such for only short periods.

The month opened with a slight barometric depression passing into the lower St. Lawrence Valley attended by light precipitation in the Canadian Maritime Provinces and the northern portions of New York and New England, and showers, some comparatively heavy, had fallen during the previous 24 hours locally in the Gulf States and the southern drainage area of the Ohio. The following day falling pressure overspread the central Great Plains and local showers occurred over portions of the Dakotas and southeastward to southern Lake Michigan, and widely scattered light rains continued in the Gulf States and occurred at points along the Atlantic coast. The depression over the central Plains moved eastward to the lower Lake region by the morning of the 3d, attended by general rains from the upper Mississippi Valley eastward to and including much of the Ohio Valley. This storm moved to northward of the lower St. Lawrence Valley by the morning of the 4th, and rain occurred from the lower Lakes and Ohio Valley northeastward to the Atlantic coast and the adjoining Canadian Provinces.

Another low-pressure area (cyclonic storm) had formed over the lower Missouri Valley by the morning of the 5th, attended by showers at points near the center, and had moved southeasterly by the morning of the 6th, but precipitation was still limited to small areas near and to northward of the center, the largest recorded fall (nearly 3 inches) occurring at St. Louis. This storm appears to have lost energy quickly and by the morning of the 7th had largely dissipated.

No important depression of the barometer occurred thereafter until about the 12th, though local showers were recorded each day somewhere within the area from the Rocky Mountains eastward, but the amounts were mainly small and contributed but little useful moisture save near the east Gulf and Atlantic coast districts about the 12th.

By the morning of the 13th a disturbance (cyclonic storm) was central over Lake Superior and scattered showers had occurred from the valley of the Red River of the North eastward to Michigan, though they, too, were mostly light; but farther south local showers, some heavy, had also occurred from Arkansas eastward to the coast. During the following two days the cyclonic conditions over Lake Superior moved northeastward and finally entered the lower St. Lawrence Valley, giving some good rains locally in the Northeast sections, while the rainy conditions existing in the Gulf States moved eastward and by the morning of the 15th had generally disappeared, at which time clear weather existed in nearly all parts of the country.

No precipitation of consequence was recorded thereafter until the morning of the 19th, when local storms were reported quite generally along the Atlantic coast from Key West to Boston. On the following two days precipitation continued over the southern portion of this district and again on the 22d, extending at this time westward to the Texas coast. Local showers became more prevalent on the 23d, occurring over a rather narrow strip from Arizona northeastward to the vicinity of southern Lake Michigan and thence southeasterly to near the middle Atlantic coast, and showers continued in the Gulf coast districts. The amounts of precipitation over these areas were usually small, however, and afforded only slight relief in important drought areas.

Some showers occurred over a considerable area from the Ohio Valley northeastward to the middle Atlantic coast and New England on the 24th and from eastern Texas to the Carolina coast on the 25th, and locally in parts of Florida on the 26th, 27th, and 28th and at a few other points, particularly in the Southwest, but otherwise there was little precipitation until the end of the month, at which time the severe drought still existing over the major portions of the country was practically unrelieved.

Anticyclones dominated much of the country during the month, favoring dry and cool weather for the period of the year, but they were not sufficiently strong to cause important frosts.

The average pressure for the month, reduced to sea level, was comparatively high and above normal in all portions of the United States and Canada, save over a narrow strip along the coast from Florida northeastward to the eastern Canadian Provinces and over a small area in the northern plateau region. The changes from similar values of July were mostly small, the August pressures being generally less than those for July from Texas and Oklahoma northeastward to the St. Lawrence Valley and over the immediate Pacific coast and the far Northwest. Over most interior districts the pressures for August were higher than those for July.

Local storms were infrequent, but were severe in a few localities, material damage from hail to the tobacco crop occurring in the vicinity of Hartford, Conn., on the 1st and in portions of Wisconsin on the 13th. Tornadoes occurred at a few points, but they were not severe and no deaths resulted therefrom, though five persons lost their lives in other wind storms. The details of damaging storms appear at the end of this section.

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TEMPERATURE

In many central and eastern districts August was a distinctly pleasant month as concerned the temperature and even in the Middle West frequent changes from cool to warm, or vice versa, made the weather comfortable on the whole. In the far Northwest, however, the weather was warm almost throughout; at some points the daily averages were normal or above nearly every day; and in several States the monthly means for the entire State were the highest of record.

The changes in temperature from day to day were mainly small, but sufficient usually to give welcome physical variation. In only one period, 24th–25th, was the daily change in excess of 20°; this occurred in the valley of the Red River of the North, when unusually cool weather for the season overspread most sections of the Northwest and frosts were recorded at a number of points, but no material damage to crops was sustained.

The average temperature for the month was below the normal over nearly all districts from the Mississippi River eastward save in portions of the Middle Gulf States, the deficiency ranging up to as mush as 4° in the Ohio Valley and Northeastern States.

West of the Mississippi Valley the temperatures were everywhere above the normal and decidedly so in the Plateau and northern Rocky Mountain States, where they ranged generally from 4° to 7° above.

The highest temperatures in most eastern and central districts occurred early in the month or during the last decade, while in the far West they occurred mostly in the second and last decades. The highest mark, 122°, was recorded in southern California on the 12th, but temperatures ranging from 105° to 115° occurred somewhere in practically all the States west of the Mississippi River. East of that river the highest temperatures usually did not rise to 100°, save in the Southern States.

The lowest temperatures were recorded mainly during the last two decades and most frequently near the middle of the month. Minimum temperatures below freezing were recorded at points along the entire northern border, the lowest reported anywhere being 22° at a point in the high portion of Oregon.

PRECIPITATION

Not in many years has the precipitation for August been so widely deficient as during August, 1929. Probably 90 per cent of the entire area had less than normal amounts, and this condition was greatly intensified by marked deficiencies in precipitation over many of the same sections during the latter part of the preceding July.

In a few localities the total precipitation was less than received in any August over more than 50 years, while at other points it was near to if not quite the least. Slight excesses in precipitation was experienced in portions of the Southwest, and small positive departures from the normal were recorded over a few scattered areas in other parts of the country, some heavy falls occurring over a considerable portion of central Iowa, particularly, on the 1st and 2d, the heaviest occurring in Tama County, where a fall of 8.27 inches occurred within a period of about two hours. This was probably the heaviest rain ever experienced in the State during so short a period of time, causing streams in the immediate vicinity to rise to or above the highest stages ever known and resulting in much damage to roads, bridges, and otherwise.

RELATIVE HUMIDITY

The dry conditions existing over the country, as a whole, are voiced by the humidity percentages, which except in a few localities, were distinctly below normal and in some instances the lowest ever recorded in August.

In portions of the upper Missouri Valley and adjacent areas in the Plateau region and also in the Great Plains and portions of the central valleys the monthly averages ranged from 5 to 20 per cent less than normal.

551.515 (08)(73)

SEVERE LOCAL STORMS, AUGUST, 1929

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards [1]	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Hartford, Conn., and vicinity.	1				$1,000,000	Heavy hail	Heavy loss to tobacco crop and much damage to greenhouses; communication lines out of order.	Official, U. S. Weather Bureau. Hartford Courant (Conn.).
Plainfield and Hammonton, N. J.	1					Wind and hail	Trees uprooted; glass in windows broken; fruit trees injured.	Official, U. S. Weather Bureau.
Tama, Webster, Grundy, and Marshall Counties, Iowa.	1	11 p. m.			50,000	Wind	Character of damage not reported	Do.
Kossuth County, Iowa	2	1:30 a. m.	3 mi.		150,000	Tornado	Extensive damage to crops and property. Path 12 miles.	Do.
Iowa (18 counties)	2	12:01–6 a. m.				Wind	Much damage to crops, chiefly corn	Do.
Marshall County, Kans.	2	4:30 p. m.			250	Violent wind	Trees and small buildings blown down	Do.
Hay to Reparia, Wash.	2	5–6 p. m.			9,000	Hail	Standing grain damaged	Do.
Durango, Colo.	3	6:30 p. m.	2,640			Hail and wind	Considerable damage to property in mining district.	Do.
Yuma, Ariz. (10 miles south of).	3				15,000	Wind	3 small buildings demolished, many others damaged; several persons injured.	Do.
Burton, S. C.	4				3,000	Thunderstorm	A barn and contents destroyed by lightning	Do.
Las Cruces, N. Mex. (near)	6	3:30–5 p. m.				2 hail storms	Heavy damage to alfalfa and fruit	Do.
Hannibal, Mo.	6				2,000	Electrical	Church damaged by lightning	Do.
Oshkosh, Wis. (near)	9				5,000	Hail	Damage chiefly to fruit	Do.
Cheyenne, Wyo. (south of)	10	3:20 p. m.				Tornado	No details. Storm passed some distance from station, probably in near-by Colorado.	Do.
Harrison County, Iowa	10	1 p. m.				do	No damage, cloud did not touch ground	Do.
Mills, Cherokee, and Lyon Counties, Iowa.	11	P. m.				Hail and wind	Crops badly injured	Do.
Van Buren, Tama, Jefferson, and Keokuk Counties, Iowa.	12	do				do	Considerable crop damage	Do.
La Crosse, Vernon, Monroe, Columbia, Dane, and Rock Counties, Wis.	13	6:35–10 a. m.	1–5 mi.	1	900,000	do	Severe damage to corn, tobacco, greenhouses, and buildings over path 45 miles long.	Do.
Adams County, Pa. (south-central).	13	3–4 p. m.				Heavy hail and wind.	Chief damage to crops; many windows broken	Do.
Macoupin, Montgomery, and Christian Counties, Ill.	13	4 p. m.	8 mi.			Hail	Crops injured 40 to 50 per cent; greenhouses and auto tops damaged. Path 20 miles.	Do.
Stoughton, Wis. (near)	13	4:30 p. m.			2,000	do	Crops, chiefly tobacco, damaged	Do.
Newton, Ill. (near)	13	6:30 p. m.	60		300	Small tornado	No details of damage reported. Path 1 mile long.	Do.
Sumner, Altamont, Sparta, and Literberry, Ill.	13	P. m.				Wind, electrical, and hail.	Barns and buildings damaged by wind and lightning; much crop injury.	Do.
Boyertown, Pa.	13–14				100,000	3 thunderstorms	Much damage to property in Oley Valley; several buildings demolished; 2 persons injured.	Do.
Philadelphia, Pa., and vicinity.	14	2–4 p. m. 8:45 p. m. to midnight.		4	75,000	Thunderstorms and wind.	Loss chiefly to crops; other minor damage	Do.
Ferndale, Md.	14				3,500	Wind	Building unroofed and otherwise damaged	Do.
Freeport Mills, Pa. (near)	14				13,500	Electrical	3 barns and contents destroyed	Do.
Franklin, Manor and Fayette Counties, Ohio.	14				17,265	Wind and electrical.	Considerable damage to property	Do.
Stevensville, Md.	14					Eletrical	2 houses and a barn destroyed	Do.
Fort Lupton, Colo. (near)	18		1,760			Hail and electrical.	Severe storm accompanied by lightning. No details of damage.	Do.
Quakertown, Pa. (near)	18–19		1,760		7,500	Hail	Crops badly injured; trees uprooted; windows broken.	Do.
Henderson, N. C.	19		1–3 mi.		50,000	do	Corn, cotton, and tobacco ruined	Do.
Crandon, S. Dak.	21	6. p. m.			1,000	Wind and hail	A few small buildings wrecked; some damage to crops.	Do.
Oconomowoc, Wis. (near)	22				20,000	Electrical	Considerable damage by lightning	Do.
Providence, R. I.	23	10:32–11:45 p. m.				Thunderstorm	Electric service disrupted; 500 telephones out of order; 4 buildings struck by lightning.	Do.
Homestead, Pa.	23	P. m.			10,000	Electrical	Power plant damaged; several buildings struck by lightning.	Do.
Ottawa, Ill.	23				50,000	do	Several buildings burned	Do.
Saline County, Ill. (northern).					3,000	do	Several buildings damaged	Do.
Portage, Ohio	23–24					do	3 barns and 1 building destroyed; several houses struck by lightning.	Do.
Groton, S. Dak. (near)	24	4:30 p. m.			25,000	Wind and hail	Buildings destroyed or damaged; cattle killed	Do.
Rock Hill, S. C.	24					Hail	Considerable crop damage	Do.
Atchison County, Kans.	25	6:30 p. m.			600	Small tornado	Freight house and filling station damaged	Do.
Clarke County, Iowa	25	6 a. m.				Hail and wind	Much corn blown down	Do.
Vineland, Kans. (near)	25		3 mi.		50,000	Heavy hail	Extensive injury to corn crop over a 3-mile path.	Do.
Harrisburg, Pa.	27	1:52–4:10 p. m.			10,000	Electrical	Farm property destroyed	Do.
Buena Vista, Colo.	27	5:30–8 p. m.	880–1,320		5,000	Rain and hail	Entire crop of grain, hay, lettuce, and peas was completely destroyed.	Do.
Hampshire County, W. Va.	27		1,760		15,000	Hail	Crops injured	Do.
Harrisburg, Ill. (near)	27				6,000	Electrical	Several buildings damaged; livestock killed	Do.
Groveton, Tex. (near)	28	2:40 p. m.				Wind	Corn and cotton blown down; 2 farm homes unroofed; several barns and outbuildings wrecked.	Do.
Woodruff, S. C.	29	4. p. m.	1,460–7,040		200,000	Hail	Heavy damage to crops and property over path 8 miles long.	Do.

[1] Mi. signifies miles instead of yards.